Twenty-first Annual Report

OF THE

North Dakota Agricultural Experiment Station

Agricultural College, North Dakota

TO

The Governor of North Dakota

1911

Twenty-first Annual Report

OF THE

North Dakota Agricultural Experiment Station

Agricultural College, North Dakota

TO

The Governor of North Dakota

1911

LETTER OF TRANSMITTAL.

Agricultural College, N. D., February 1st, 1911.

Hon. John Burke, Governor of the State of North Dakota.

Sir: As required by Act of Congress, approved March 2nd, 1887, I hereby submit the Twenty-first Annual Report of the North Dakota Experiment Station for the year ending February 1st, 1911, together with a financial statement of receipts and disbursements, as required by law, for the government of fiscal year ending June 30, 1910.

Respectfully,

G. H. HOLLISTER,

Pres. of the Board of Trustees, N. D. A. C.

BOARD OF TRUSTEES

Term Expires 1911.

GEORGE H. HOLLISTER, President.....Fargo
CLARK W. KELLY.....Devils Lake
JAMES RADFORD.....Warren
H. R. HARTMAN.....Page
H. D. MACK.....Dickey

Term Expires 1913.

FRANK SANFORD.....Valley City
ARJA BOWEN.....Mohall

W. A. YODER, Secretary, Agricultural College.
W. P. PORTERFIELD, Treasurer, Fargo.

STATION STAFF.

J. H. WORST, LL. D., Director.
E. F. LADD, B. S., Chemist.
C. B. WALDRON, B. S., Horticulturist and Entomologist.
H. L. BOLLEY, M. S., Botanist and Plant Pathologist.
J. H. SHEPPERD, M. S. A., Agriculturist and Vice-Director.
LEUNIS VAN ES, M. D., V. S., Veterinarian.
O. O. CHURCHILL, B. S., Asst. Agriculturist (Farm Crops).
W. B. RICHARDS, B. S. A., Asst. in Animal Husbandry.
W. B. BELL, PH. D., Asst. Botanist (Plant Survey).
R. M. DOLVE, B. S., Asst. Agriculturist (Engineering).
ADELE SHEPPERD, Asst. Chemist (Waters).
*O. W. DYNES, B. S., Asst. in Animal Husbandry (Poultry).
T. D. BECKWITH, M. S., Asst. Bot. (Bac. and Plant Path).
W. F. SUDRO, B. S., Asst. Chemist (Drugs).
R. E. REMINGTON, B. S., Asst. Chemist (Foods).
W. L. STOCKHAM, M. S., Asst. Chemist (Oils).
J. W. INCE, A. M., Asst. Chemist (Soils).
H. L. WHITE, M. A., Asst. Chemist (Cereals).
ADOLPH ZIEFLE, PH. C., B. S., Asst. Chemist (Drugs).
H. F. BERGMAN, B. S., Asst. Botanist (Mycology).
R. C. DONEGHUE, M. S., Asst. Agr. (Soils and Plant Br.).
THOMAS SANDERSON, Miller.
ORIN A. STEVENS, B. S., Asst. Botanist (Seed Analysis).
E. D. HARRIS, D. V. M., Asst. Veterinarian.
G. L. MARTIN, B. S. A., Dairyman.
C. H. BAILEY, Assistant Chemist (Baker).
E. B. PUTT, PH. C., B. S., Asst. Chemist (Beverages).
A. F. SCHALK, D. V. M., Asst. Veterinarian.
L. P. NEMZEK, B. S., Asst. Chemist (Paints).
LEVI THOMAS, M. S., Asst. Chemist (Cereals).
ANDREW McMEANS, Asst. Horticulturist.
E. E. WARE, B. S., Asst. Chemist (Paints).
M. L. DOLT, PH. D., Asst. Chemist (Textile Fibres).
E. J. THOMPSON, B. S., Asst. in Animal Husbandry.
H. R. RAFSKY, A. B., Asst. Chemist (———).
D. G. MILBRATH, A. B., Asst. Botanist.
C. V. KENNEDY, Farm Foreman.
W. A. YODER, Secretary.

*Granted leave of absence of one year.

SUB-STATIONS AND DEMONSTRATION FARMS.

EDGELEY SUB-STATION.

O. A. THOMPSON, B. S., Superintendent.
CLARENCE PLATH, B. S. A., Asst. Agriculturist.*

DICKINSON SUB-STATION.

L. R. WALDRON, M. S., Superintendent.
JOHN THYSELL, B. S. A., Asst. Agriculturist.*
J. ALLEN CLARK, B. S. A., Asst. Agriculturist.

WILLISTON SUB-STATION.

E. G. SCHOLLANDER, B. S., Superintendent.
F. R. BABCOCK, B. S. A., Asst. Agriculturist.*
W. O. WHITCOMB, B. S. A., Asst. Agriculturist.*
A. M. HAWLEY, Asst. Agriculturist.*

LANGDON SUB-STATION.

E. D. STEWART, B. S., Superintendent.

HETTINGER SUB-STATION.

W. R. LANXON, B. S. A., Superintendent.
HAROLD McKINSTRY, B. S. A., Asst. Agriculturist.

DEMONSTRATION FARMS.

W. R. PORTER, B. S., Superintendent.
M. B. JOHNSON, Asst. Superintendent.
W. A. YODER, Secretary.

*Detailed to this sub-station from the U. S. Department of Agriculture for Co-operative work.

REPORT

To the Board of Trustees of the North Dakota Agricultural College and Experiment Station:

Gentlemen:

I have the honor to submit herewith the Twenty-first Annual Report of the North Dakota Government Experiment Station.

The following bulletins were published during the year.

No. 88. Windbreaks and Hedges.....C. B. Waldron

No. 89. Wheat Investigations, Milling, Baking, and Chemical Tests .....E. F. Ladd, C. H. Bailey

No. 90. Potato Culture.....J. H. Shepperd, O. O. Churchill

No. 91. Dairy Herd Records.....
.....J. H. Shepperd, W. B. Richards

PRESS BULLETINS.

No. 39. Growing Flax on New Land.....H. L. Bolley

No. 40. Growing Flax on Old Land.....H. L. Bolley

No. 41. Who Can Save the Flax Crop of the Northwest?
.....H. L. Bolley

No. 42. Essentials of Flax Cropping.....H. L. Bolley

DAIRY BUILDING.

I can only repeat my recommendation of one year ago, which is as follows: "The dairy interests of the state make it imperative that we erect a suitable plant for instruction and experimentation as soon as the finances of the state will

warrant. Under present lack of facilities, instruction in butter-making is offered, during the winter months only, while all lines of experimental work is held in abeyance, pending the erection and equipment of a suitable dairy laboratory. A model dairy barn is also contemplated as well as a selected dairy herd of cattle.

"A fine field for experimental feeding for milk production is offered as well as how best to care for dairy cows where the winters are long and severe. Different breeds of dairy cattle should also be tested, both for profitable milk production and adaptation to local climatic conditions."

The 12th Legislative Assembly failed again to make any provision for experimental or educational work in dairying, hence it will be at least two years before the matter of dairying can be given any legislative consideration whatever. The fact that the state is not financially able to inaugurate propagandas for the development of her tremendous latent resources is deplorable, the more so from the fact that the state must remain poor until her latent wealth is developed.

EXTENSION WORK.

Extension work has been carried on during the past year along several lines but confined chiefly to lecture courses and corn and vegetable growing contests among the school children of the state. Fully eight thousand school children participated in these contests. Many prizes were offered for those securing the best results and the winners of prizes were given a week at the Agricultural College, where they were entertained with lectures and object lessons intended to enlarge their understanding of agriculture and subjects closely related to it. The demand for this work is constantly growing. The work will, doubtless, be extended somewhat during the coming year.

DEMONSTRATION FARMS.

Twenty-four demonstration farms were operated during the past year. Notwithstanding the severe drouth which prevailed generally, the yields of grain secured from the demonstration farms were fully double the average obtained by farmers throughout the state.

The Legislative Assembly appropriated an additional $6,000 annually for the purpose of adding twelve more demonstration farms in as many different counties. The purpose of these demonstration farms being to determine the advantages of a perfect crop rotation in which corn, barnyard manure, and clover (or Canada field peas) shall have a regular place, cannot fail to enlist the attention of progressive farmers generally. The rotation also involves deep plowing, perfect tillage, and the use of pedigreed seed grain.

SUB-EXPERIMENT STATIONS.

Five sub-experiment stations are located in different parts of the state, each under the management of a competent superintendent and trained assistants. The work of these sub-stations is under the direction of the Government Experiment Station at Fargo and may be considered detached portions of the regular experiment station propaganda. All are doing excellent work and are attracting considerable attention in the localities in which they are situated.

J. H. WORST,
Director.

AGRICULTURAL DEPARTMENT

To Director J. H. Worst.

Sir:

The work of the Agricultural Department has followed the same general lines as described in my twentieth and preceding reports. Some phases of it have been expanded and other contracted somewhat as the case seemed to me to require.

The twenty-four demonstration farms and five sub-stations have taken considerable of my time during the past year but as that work is reported upon in special publications for each of these sub-stations and for the demonstration farms, I will only allude to them here.

The dry land farming trials are largely restricted to the sub-stations and demonstration farms by reason of their being located where that work can be carried on to the best advantage.

The correspondence during 1910 for the department ran about 5,000 letters, about 2,600 of which I wrote personally. While this is a considerable load on the department in itself, I believe it is one of the vital aids to our people and I would not, therefore, suggest any curtailing of it. Circular letters and press bulletins have been issued to cover these lines as far as possible and have greatly reduced the work by enabling us to refer to discussions covering many of the questions asked.

O. W. Dynes who has been assisting in the live stock work, taking the greater portion of the responsibility for the poultry plant and assisting some in the plant breeding was given a leave of absence for one year beginning September, 1910, in order that he may pursue further studies along these lines.

O. O. Churchill handed in his resignation to take effect the first of January, 1911, in order that he might accept a more lucrative and responsible position with the Oklahoma

Experiment Station and Agricultural College. Complete arrangements for filling this position have not been made up to this time.

In outlining the work for the department I have made a study of the agricultural conditions of the state and have attempted to cover the field with the agricultural department, the sub-stations and demonstration farms and have attempted to avoid unnecessary duplication.

The live stock statistics compiled by the U. S. Government indicate that the number of domestic animals in this state has decreased. This, I believe, is largely the result of the breaking up of the ranges in the western portion of our commonwealth. The small farmer who has displaced the ranchman should, if equipped to the best advantage, produce as much live stock in that region as his predecessor did. Most of those people do not have much live stock at present and many of them know very little about caring for animals.

A general change in the cropping practice is necessary in all parts of this state and with the change must come an increase in the number of domestic animals kept on the farms. In the eastern, more humid parts of the state, this change is necessary on account of the land having become infested with weeds and having been reduced in productiveness to the extent that the leguminous crops and the addition of stable manure is required. In the drier regions of the state frequent changes to a cultivated crop and the addition of humus supplying materials is the only way to combat dry seasons and to bring maximum results in average or normal years.

I have anticipated the coming of this time and condition and hence have a large amount of data at hand showing what can be done both with corn and clover as crops to be used in rotation. I have also introduced experiments with field peas and am prepared to submit a practical plan of crop rotation for all districts of the state. These cropping plans include a cultivated crop to conserve moisture and to destroy weeds and a leguminous one to add nitrogen and humus. The growth of these two changes of crops from small grain make it necessary to keep live stock to manufacture them into salable commodities and I have had as much experiment work carried on in the feeding out of

live stock as our facilities will permit. I have given a considerable time to the encouragement and education of the people towards the proper care and management of the different classes of meat stock and dairy cows.

Our people make many mistakes and are frequently discouraged when they attempt to adopt these new systems or farming and I have found it advisable to spend a good deal of effort in demonstrating successful means of carrying out mixed farming plans. The experiment work carried on, may be grouped as follows:

The work of the demonstration farms consists in applying methods worked out on the station and sub-stations to the conditions in the twenty-four counties where they are located. A special report on these farms indicates that they have demonstrated that the yield of wheat can be doubled by applying methods which we have worked out, to the farms of the state.

The sub-stations have been given largely specific problems to work out and demonstrations to make for their respective districts of the state.

At Williston heavy stress is laid on methods of irrigating crops and a study of the successful crops and systems of cropping for that irrigation project.

At the Dickinson Sub-Station the heaviest line of work has been to determine the most successful alfalfa strains and the best methods of culture for that crop.

At Edgeley a strong study has been made with durum wheats, drouth resisting cereals in general and on brome grass and alfalfa as pasture and forage crops.

The Langdon Sub-Station's work has been outlined largely as a demonstration of the system of farming advisable for that region.

At Hettinger the sub-station is only opening for work. It is proposed to put heavy stress on horticulture and upon demonstrating the better methods of carrying out cropping systems for that region.

Our Sub-Station superintendents have been encouraged in giving information and assistance to their neighbors on planting farm groves, tree plantations, testing seeds, planning cropping systems, etc., and by attending institute meetings, agricultural clubs and through farm-to-farm visits.

On the central station grounds a trial to determine what

commercial fertilizers should be used and what value they represent in increased crops has been a line of study carried out. The answer to a similar question concerning the use of stable manure is also under investigation. The effect of different cropping methods in the accumulation of humus and nitrogen in the soil is being carried out. Along with these a number of studies in cultivation methods such as, the best way to prepare corn ground for a grain crop, deep and shallow plowing, harrowing grain, thickness of seeding and depth of planting have been carried as side studies.

The work in plant breeding has been expanded, as the importance of it became evident from the scientific standpoint and from the production and distribution of such strains as North Dakota No. 316 blue stem, No. 388 oats, No. 871 barley, No. 155 flax, No. 950 corn, No. 959 rye and several other distributed superior strains.

These improved varieties are now distributed largely by means of the twenty-four demonstration farms and five sub-stations in pure form, thoroughly cleaned as shown by the inspection by officers of this station and sent out under a seal of the institution as positive evidence that they are pure and of the genuine strain represented. These improved seeds have already almost wholly supplanted the original sorts and have won their way by proving their superiority in the hands of the grain growers of the state.

It is needless for me to go into detail concerning the work of the plant nursery more than to say that it is a selection of the best yielding varieties which in turn show a good grade and high economic value in such points as stiffness of straw, proper holding of chaff, milling and bread making qualities. A hybrid between the improved 959 rye and Turkey red wheat is giving very promising results for the future. In the corn breeding, our results are very striking, the yields from the ear to row breeding trials giving a range of from 33 to 96 bushels per acre. It should be remembered, of course, that the extra care which can be given to small plats makes all of their yields high as compared with what may be secured in a field way. It is a more accurate comparison than can be made of fields, however, and is quoted here to show that marked improvement is possible. With small plats accurate data on the number

of barren stalks, percentage of stand and other data that has a bearing on the value of a strain can be recorded.

The season of 1910 was a discouraging one in some respects on account of the severe drouth and the scourge of grasshoppers. In the breeding nursery in some cases these two menacing elements left us indeterminate as to the comparative value of our results.

A study of farm management and of the cost of production of farm crops constitutes another line of endeavor undertaken by the department. During 1910 one hundred twenty farmers co-operated with a representative of this department in furnishing data as to items of cost in producing agricultural products on their farms. On the college farm the department has kept a detailed record of the amount of labor used on different fields and enterprises during the now nearly eighteen years of my incumbency. Comparatively little of this data has been worked up in form to publish but it contains a vast amount of dependable facts which should go far towards establishing standard points when summarized.

A trial to determine the cost of producing milk is under way and has been carried out in close detail for twenty-four cows since June 16, 1907. I have the manuscript for a bulletin giving that data together with less detailed records covering a period of about fifteen years almost completed and will be prepared to submit it to you for publication as a bulletin within a few weeks.

Experiments with pigs have been carried out to determine the results to be secured from a special method of feeding and exercising the brood sows during the winter season. The lack of proper drainage for the pasture lots to be used in supplying green forage to pigs during the growing season together with the dry weather which occurred during the past summer have seriously interfered with trials undertaken to determine the economy of production by the use of these green crops. We have lost the results of trials which would amount to very much more than the cost of laying the few lines of tile which would have prevented the failure. This trial has been interrupted in this manner each season during the past three years. The department has already demonstrated the feasibility of using barley as a fattening ration for pigs and has shown

that its value for that purpose approaches the standard corn ration used in the corn belt region.

An interesting trial with sheep is being carried out to determine whether a strain of mixed blood in its foundation can be produced which will be better adapted to our west state conditions of exposure during winter than any existing breed. At the present time there is no breed that seems to be entirely satisfactory for exposed range conditions.

A full equipment of trap nests in our poultry houses have enabled the department to secure interesting and important data from the effect of in and in breeding of fowls also to demonstrate the rapidity with which grades equal to the full blood in type and breed value may be produced.

A study of systems of ventilating poultry houses in winter has resulted in the discovery of a plan which gives healthy fowls and increases the number of eggs produced. The experiments in comparing cold and warm housing have indicated that most residents of our state have not suffered from cold housing of their poultry but rather from poor ventilation. Close yarding as compared with allowing them wide range has brought out the fact that reasonable close confinement is not so serious a handicap as it is ordinarily considered and that the difference in results is more a matter of regular food supply than of yarding or having wide range. Breeding for high egg production is giving gratifying results and is following the same general upward tendency that is shown in the results already published.

Trials with systems of drainage tile gave very markedly different results in the dry season of 1910 as an outcome of the better mechanical condition of the soil which has been well taken care of during wet seasons by having the tile to carry off surplus water compared with neighboring fields and plats which had not been under-drained. Some interesting data has been secured as to the distance between laterals of tile necessary in this state also the time that frost comes out of the ground above the tile which will enable it to carry off the surplus water in the spring. The quickness with which water will percolate into tile and be carried off from the soil has been observed and recorded.

During the dry season of 1910 some studies were made on the conservation of moisture by different cropping sys-

tems as a means of bringing out data in verification of our investigations of 1900.

The detail of the specific lines of investigation have been under the direct charge of those who are associated with me in carrying out the work of this department and the results that we have secured are largely attributable to their efficient efforts in recording data and making observations on the phenomena as they occurred. My thanks are due and hereby tendered to them for this efficient service.

Respectfully submitted,

J. H. SHEPPERD,

Agriculturist and Vice-Director.

CHEMICAL DEPARTMENT

To J. H. Worst, Director:

Sir:

I herewith present my Twenty-first Annual Report as Chemist of the North Dakota Government Agricultural Experiment Station for the calendar year of 1910. The work has been very seriously handicapped during the past year for want of proper laboratory facilities in the various lines of work which had been previously undertaken, owing to the fact that our Laboratory was destroyed in December, 1909, and the new building has not been completed so as to enable us to occupy it. The work, however, has covered a wide range of subjects, not only in research lines but also in connection with the enforcement of the Laws which it is made the duty of this Department to supervise. It has, therefore, become necessary to divide the work of the Department into several divisions. The principal divisions at the present time are:

1. Division of Agricultural Chemistry.
2. Division of Industrial Chemistry.
3. Division of Food Chemistry.
4. Division of Physiological Chemistry.
5. Division of Water Analysis.
6. Division of Pharmacy.
7. Division of Beverages.
8. Division of Milling Experiments.
9. Division of Baking and Testing.
10. Division of Illuminating Oils and Gasolines.
11. Division of Meteorology.
12. Division of Inspection.

While a sharp line cannot be drawn between the several divisions of work, each division has its own definite line, though at times it is found necessary for one division to give material assistance in the work of another division.

The principal lines of work in the several divisions during the past year may be summarized briefly as follows:

Division of Agricultural Chemistry—J. W. Ince, Chief of Division. The analysis of soils, including the continuation of test upon soils taken from the several demonstration farms and branch stations; a study of plant nutrition; further investigations on the subject of humus; the analysis of stock foods, feeding stuffs; paris green, fertilizers, sugar beets and other samples submitted by the people of the state.

Division of Industrial Chemistry—E. E. Ware, Chief of Division. The work in this division has been largely confined to the analysis of paints, oils, turpentines and varnishes; the examination of fuels, building material, clay; and a continuation of the experiments made in the practical testing of paints and paint products.

Division of Food Chemistry—Roe E. Remington, Chief of Division. Many of the lines of work in this division have been in connection with the enforcement of the Pure Food Law of this state which has made it necessary to analyze a large number of samples of food products for the detection of adulteration and foreign ingredients; studying the effects of different methods of preserving and handling foods; determination of the character of the more harmful ingredients found in food products; and the examination of many samples as submitted by manufacturers, dealers and the consuming public.

Division of Physiological Chemistry — H. L. White, Chief of Division. A study of the acidity in flours; determination of the acidity in bread by different methods of treatment and keeping; a study of the gluten and its relation to the expansive properties in flour in bread making; a study of the acid properties of gluten and ash content; and the examination of various products submitted, including the analysis of urines and physiological products.

Division of Water Analysis—Adele Shepperd, Chief of Division. In this division attention has been devoted almost entirely to the analysis of waters as submitted by the people of the state. This may seem as a matter of interest

only to the individual submitting the sample, but if we consider the great variety and many classes of waters to be found in the state, and the fact that much injury is done to animals, as well as to man, where the supply of water is of poor quality, and the importance of having water of a satisfactory quality for the purpose of irrigation and sprinkling of lawns, makes the work of unusual importance to the people of the state. Since the destruction of our laboratory, December 24th, 1909, there have been analyzed 410 samples of water, approximately two samples per day for each working day. For these samples the amount of solids has ranged from 100 parts to more than 24,000 parts per million, and with a marked variety of salts in the waters from the various sources.

Division of Pharmacy—Adolph Zieffle, Chief of Division. This division has been largely engaged in the examination of drugs, patent medicines and proprietary products as taken up at the drugstores throughout the state. This work has been done in order to determine the variation in strength of products as compared with the U. S. Pharmacopoeia, or with the claims as made upon the labels for patent medicines, and proprietary products. Experiments have been carried on in order to determine the amount of deterioration of various drug products when put up under different conditions; also the examination of products as submitted by physicians, druggists, and people of the state.

Division of Beverages—W. F. Sudro, Chief of Division for Alcoholic Beverages, and E. B. Putt, Chief of the Division for Wines, Malts, etc. A large amount of work has been undertaken in this division in connection with the examination of practically all of the soft drinks, fermented liquors, malts, etc., as found upon the markets or shipped into the state of North Dakota. The result of these investigations are given in Part II of this Report.

Division of Milling Experiments—T. Sanderson, Miller. The work here has been in co-operation with the U. S. Department of Agriculture and this has given us opportunity to make milling tests of wheats from all parts of the country and of all classes and varieties. Much of the data re-

sulting from these experiments has been given in special bulletins and in bulletin No. 89. Among the problems considered are the following: A study of Durum vs. Spring Wheats as to their Milling Qualities; An examination of the milling and baking qualities of velvet chaff wheat; different methods of tempering wheat for milling; the effect of methods of storing; the testing of bin-burned wheats and frosted wheats; wheats threshed from the stalk as compared with wheats threshed from the shock; tests made upon plants as produced at the different demonstration farms and branch stations throughout the state. The data secured will be given in forthcoming bulletins and reports of the Department.

Division of Baking and Testing—C. H. Bailey, Chief of Division. Mr. Bailey has had charge of all the baking tests with various flours as milled for the experiments outlined above, and with the assistance of Mr. Thomas has made a study of the water content of wheat for milling tests. A large amount of available data has been secured which, in connection with the milling tests, is given largely in bulletin No. 89.

Division of Illuminating Oils and Gasolines—W. L. Stockham, Chief of Division. The State Law makes it the duty of this Department to make examinations and tests of oils and gasolines as submitted by the state inspector of oils. A large number of tests have been made including the determination of the gravity, fire test, flash test, distillation tests, and the determination of sulfur or other ingredients present in illuminating oils; the determination of the value of the several oils as illuminants. Considerable attention has also been given to a study of the qualities of gasolines and methods devised whereby inferior grades can be detected.

Division of Inspection—L. A. Congdon, Chief Inspector. The importance of this work is easily understood when we consider the necessity of visiting all parts of the state for the purpose of securing samples to determine whether the same are in compliance with the Law of the state. This includes the examination of commercial fertilizers, formaldehyde, paris green and feeding stuffs as well as products

under the Food, Drug, Beverage and Sanitary Inspection Laws of the state.

During the year there has been prepared and published by the Department bulletin No. 89 entitled Wheat Investigations, Milling, Baking and Chemical Tests.

Four paint bulletins have also been published; Part I, Report on the Surface Condition of Paints by a Committee representing the Paint Manufacturers' Association of the United States; Part II, Report on the Surface Condition of Paints by a Committee representing the National Lead Company; Part III, Report on the Surface Condition of Paints by a committee representing the Picher Lead Company; and Part IV, Report on the Surface Condition of Paints by John Dewar, representing the International Association of Master Painters and Decorators of the United States and Canada.

A number of special circulars have been issued during the year dealing with various subjects in connection with the inspection work, also several special bulletins as follows:

Special bulletin No. 20: Analysis of foods; registration of beverages for 1910.

Special bulletin No. 21: Analysis of foods, formaldehydes, lignite coal and feeds.

Special bulletin No. 22: Analysis of foods, Sioux Stock remedies and paints.

Special bulletin No. 23: Analysis of paints, foods, drinking waters, paris green, formaldehyde and turpentine.

Special bulletin No. 24: Analysis of a large number of whiskies; milling and baking tests with durum and hard spring wheats; and the analysis of food products.

Special bulletin No. 25: Discussion of slaughterhouse refuse; analysis of foods and drugs; a study of velvet chaff vs. hard spring wheats.

Special bulletin No. 26: Analysis of foods; a study of the wrapping of bread; determination of the acidity of bread; the score for various grocery stores as examined and reported upon in the state; milling and baking tests with velvet chaff and hard spring wheats.

Special bulletin No. 27: The examination of a product sold as Enzyme flour; analysis of foods and illuminating

oils; sanitary score for slaughterhouses in the state; analysis of a large number of wines, also of canned tomatoes.

Special bulletin No. 28: Deals with the stopping of frauds in foods; higher education for pharmacists; prerequisite laws in Pharmacy; velvet chaff wheat; sanitary score for ice cream factories; analysis of foods and drugs; method for the determination of water in pastes and mixed paints.

WHEAT STUDIES.

There has been considerable discussion not only as to the relative value for flour and bread production of the so-called hard spring wheats as compared with durum wheat, but also with regard to the cost of milling. Many maintain that it is considerably more expensive to reduce to flour durum wheat than the average hard spring wheat. There has also been considerable controversy with regard to the relative value of hard spring wheats as compared with velvet chaff wheat as grown in North Dakota. During the past year a number of experiments have been carried out intending to throw some light on these questions, and the results are given herewith:

THE COST OF MILLING HARD SPRING WHEATS AND DURUMS.

In order to determine just what difference there is in the cost of grinding hard spring and durum, it was decided to make a test at the Agricultural College mill. In order that we might have absolutely accurate reading with regard to the amount of power required for the several tests, an expert from the Union, Light, Heat & Power Company was employed to use a special metre and make the measurements and calculations. The milling tests were made by Mr. T. Sanderson, an experienced miller, who is in charge of the mill. Three tests were made with each class of wheat, and the following gives the results for the several tests:

Number of Samples	Grade and Kind of Wheat	Weight of Wheat Milled	Percent Total Flour	Percent Loss in Milling	Percent Moisture before Milling	Time of Milling Hr., Min.	Horse Power Per Hour	Average Horse Power per Hr.
	Durum							
482	No. 1	299	68.9	00.2	14.3	1-52	20.9 5	
570	No. 1	298	69.3	.0	15.7	2-00	20.00	
570A	No. 1	298	67.5	1.3	15.6	1-40	24.460	22.01
	Hard Red Spring							
40H	No. 1	298	69.9	2.9	15.5	1-50	19.654	
568	No. 1	299	73.4	0.2	16.0	1-40	19.55	
569	No. 1	298	69.9	1.0	15.5	1-45	19.078	19.42

Combining the results in each of the above tests the mean for the three under each group is as follows:

MEAN FOR	Total Lbs. Milled	Average Percent Total Flour	Percent Loss	Percent Moisture	Average Time Hr.—Min.	Average Horse Power per Hour	Percent Horse Power Per Hour
Durum	895	68.56	0.5	15.2	1-50	22.01	53.13
Hard Red Spring	895	70.40	1.36	15.6	1-45	19.42	46.86

In other words, to produce 100 barrels of flour of durum and hard spring wheats, 53.13 percent of the total horsepower per hour was required for the durum and 46.86 percent for the grinding of the hard spring wheats.

Now let us see what the cost of production of one barrel of flour would be based on the results of these experiments and at the market price for the two wheats. According to the market reports in the Northwestern Miller for June 6th, 1910, Durum wheat on track in Minneapolis sold at 80½ cents per bushel; No. 1 Hard Red Spring Wheat on track in Minneapolis sold at $1.06½ cents per bushel; a difference of 26 cents per bushel. Allowing 7 cents per barrel for the cost of the fuel and 35 cents for other manufacturing expenses, the cost of 100 barrels of flour, made from the above mentioned types of wheat, differences of time, power and cost of wheat considered, would be as follows:

	Cost of Fuel	Other Manufacturing Expenses	Wheat for 100 Barrels		Market Price 6-6 1910	Total Cost of Wheat	Total Cost Per Barrel
			Bushels	Pounds			
Durum	$ 7.48	$36.84	476	40	$ .80⅜	$ 383.71	$4.28
Hard Red Spring	7.00	35.00	464	01	1.06⅜	494.16	5.36

In other words, the flour has cost $4.28 per barrel for the durum, and $5.36 per barrel for the hard spring wheat, a difference of $1.08 per barrel in favor of the flour produced from the durum. The difference in the cost of power for milling and the extra time would be about 3½ cents per bushel greater for durum wheat than for the hard spring wheats. Certainly, a difference of five cents per bushel would be a wide margin, whereas, there has been a difference of fifteen to, approximately, thirty cents per bushel in the price paid for the two classes of wheat; and on the date of the test, a difference of 26 cents per bushel.

VELVET CHAFF VS. HARD SPRING WHEATS.

Several experiments were made at the mill in 1907 with velvet chaff wheat as compared with hard spring wheat and the results indicated that velvet chaff was inferior to hard spring wheat for flour manufacture and bread production. In 1908 the results were quite different. There was a very marked improvement in the quality of the velvet chaff as grown in the state, and the flour and bread produced from the same. In 1909 milling tests were made upon 22 samples of hard spring wheats and 8 samples of velvet chaff wheat; the results are shown in the following table, together with the maximum and minimum yields of flour for the several samples:

	Percent	
	Hard Spring	Velvet Chaff
Average	67.9	66.8
Maximum	74.8	72.6
Minimum	60.6	61.0

It will thus be seen that there was very little difference and this was in favor of the hard spring wheats, but had there been milled as many samples of velvet chaff wheat as of hard spring it is possible that the results would have shown even a less difference than is indicated from the small number of velvet chaff as reported upon above. In the baking tests for the samples the results were as follows:

	Water Used percent	Weight of loaf grams	Vol. of loaf c. c.	Color
22 Hard Spring samples—Average	51.4	477	2468	96.5
8 Velvet Chaff (bearded spring) samples, Aver	50.2	473	2486	96.9

From this last table it will be observed that in loaf volume the velvet chaff averaged even better than the hard spring wheats, and in color it was slightly superior to the average of the hard spring wheats. Judging, therefore, from the crop of 1909, velvet chaff proved superior to hard spring wheat in bread producing quality.

In 1910 the results for the several samples as milled in the early part of the season were published in special bulletin No. 26 and were as follows:

These wheats came from different parts of North Dakota with the exception of two samples, one of which came from Redfield, S. D., and the other from Chicago, Ill.; each sample being about two bushels. They were all cleaned over the same cleaning machines in the regular way, the weight of the sample being taken before cleaning and again after cleaning and tempering, the difference in weight taken as loss in cleaning. The sample of wheat was then run through the mill in the regular way and the weight of the different products taken. The difference between the weight of clean wheat and the weight of the total products recovered was taken as loss in milling. The flour reported as a straight includes the regular run of patent and first clear, the second clear of about five percent going to the shorts and reported as such.

The moisture as reported before and after tempering was taken in a Brown and Duvel Moisture tester.

The following tables I and II show the milling results in percentage:

Table I—Velvet Chaff.

Table II—Hard Red Spring—Fife and Bluestem.

VELVET CHAFF WHEATS.

Location	Name of Producer	Laboratory No.	Percent Loss in Cleaning	Percent Total Straight Flour	Percent Bran	Percent Shorts	Percent Total Recovered	Percent Loss in Milling	Percent Moisture Before Tempering	Percent Moisture After Tempering
Edgeley	O. A. Thompson	596	1.2	66.6	8.4	22.1	97.1	2.9	11.8	13.9
Redfield, S. D.	Otto Johnson	595	3.2	59.0	14.8	23.7	97.5	2.5	15.0	16.0
Kindred	I. C. Strand	59.	3.5	66.2	8.2	25.2	99.6	.4	11.1	14.9
Christine	G. M. Hanson	597	2.0	66.5	9.2	24.6	*100.3	*.3	11.0	13.5
Valley City	E. T. Burke	598	*.2	64.5	8.9	24.6	98.0	2.0	13.4	14.6
Dickinson	L. R. Waldron	600	*.3	65.1	10.8	20.9	96.8	3.2	14.9	15.2
Grandin	J. T. Lockhart	610	0.0	63.9	13.8	19.3	97.0	3.0	14.6	16.7
Grandin	C. H. Harkins	611	*.4	67.8	10.8	21.3	100.0	0.0	12.2	13.2
Grandin	E. W. Root	612	1.6	65.8	9.3	20.5	95.6	4.4	15.0	15.5
Grandin	John McKenzie	613	.4	66.1	13.3	19.0	98.4	1.6	13.0	15.4
Grandin	No name given	614	1.5	69.6	10.1	20.1	99.8	0.2	12.0	16.3
Wheatland	J. E. McLeod	626	1.0	61.2	15.2	20.2	96.6	3.4	14.7	16.2
Emerado	Geo. Deyberg	633	*.6	65.7	8.8	22.8	97.3	2.7	13.0	14 5
Chicago, Ill.	W. P. Carroll	635	0.3	70.3	7.6	18.3	96.2	3.8	----	13.5
Av. 14 samples		---	.94	65.6	10.6	21.6	97.8	2.2	----	---

Samples marked * made a gain.

Note 595—Called Early Johnson. Low % of flour due to excessive moisture.

" 598—Gain in cleaning due to added moisture as the wheat was very clean.

" 600—Called Red Fife. Gain in cleaning due to same cause as 598.

" 610—Very clean. Added moisture just balanced what was cleaned out.

" 611—Very clean. Gain in cleaning due to added moisture.

" 626—Low % of flour due to some extent to excessive moisture. Milled very soft.

HARD RED SPRING WHEATS.

Location	Name of Producer	Laboratory No.	Percent Loss in Cleaning	Percent Total Straight Flour	Percent Bran	Percent Shorts	Percent Total Recovered	Percent Loss in Milling	Percent Moisture Before Tempering	Percent Moisture After Tempering
Edgeley	O. A. Thompson	577	2.5	69.2	14.0	16.8	100.0	0.0	11.8	14.2
Wahpeton	A. M. Sattre	594*	1.5	67.6	10.8	19.1	97.5	2.5	12.8	14.2
Wahpeton	C. Carincross	628	6.0	70.4	7.7	21.3	99.4	0.6	11.6	12.6
Wahpeton	C. Carincross	629	0.6	67.9	8.7	21.9	98.5	1.5	11.9	14.1
Wheatland	J. E. McLeod	630	4.6	62.7	12.9	22.8	98.4	1.6	14.3	16.9
Larimore	Eastgate Bros.	631	2.4	64.2	13.	21.1	98.3	1.7	12.5	13.7
Larimore	Eastgate Bros.	632	2.2	69.1	10.8	20.0	99.9	0.1	12.6	13.2
A'v'rge percent of above samples		---	2.7	67.3	11.1	20.5	98.9	1.1	12.5	14.1

CALLED HUNCH BACK, A BEARDED SPRING WHEAT.

Kensington Minn	Kensington M. Co	634	1.9	70.5	10.9	15.8	97.2	2.8	14.1	14.7
Hoffman, Minn	A. M. Sattre	637	2.0	65.2	9.1	21.5	95.8	4.2	13.5	14.0
Average percent of above—		---	1.8	67.8	10.0	18.7	96.5	3.5	13.8	14.3

*A mixture of wheats 594 and 616 to 625 grown on same farm.

Note 630—Low % of flour due somewhat to excessive moisture. Milled very soft.

It will be seen by a comparison of the foregoing table that the average percent of straight flour from the Hard Red Spring is 1.7 per cent higher than from the Velvet Chaff, and the loss in milling 1.1 per cent lower, which are the two important factors to consider, in arriving at a conclusion, as to the price per bushel of the two varieties of wheat.

As to the power used in the manufacture, there is no perceptible difference; and as to the capacity of the mill, if any, it is in favor of the Velvet Chaff as it bolts very free. So it is quite safe to say that there is little or no difference in this respect.

Now for a comparison for the price per bushel of the wheat: Assuming that a barrel of straight flour of 196 pounds is worth $4.70, and mixed feed $21.00 per ton, then a bushel of Hard Red Spring wheat is worth $1.1691. A

bushel of Velvet Chaff on the same basis would be worth $1.1482, showing a difference of $.0209 per bushel in favor of the Hard Red Spring.

BAKING TESTS.

The baking tests for the samples of flour produced from the various wheats as indicated above were made by Mr. C. H. Bailey, representing the Office of Grain Standardization of the Department of Agriculture, Washington, D. C., working in co-operation with the milling department of this institution. The results as taken from Mr. Bailey's report are as follows:

BAKING REPORTS OF THE STRAIGHT FLOURS MILLED FROM THE VELVET CHAFF SAMPLES.
Crop of 1910.

Sample No.	Flour Used Grams	Water Used Percent	Weight of loaf gr'ms	Volume of loaf c. c.	Color	Remarks on Dough
576	334	59.4	489	2550	97	Elastic
595	340	50.0	409	2340	98	Elastic
596	341	52.4	473	2310	99	Fairly Elastic
597	337	54.1	475	2400	102	Elastic
598	340	53.8	480	2450	102	Elastic
600	340	52.9	479	2540	100	Elastic
610	343	50.0	475	2400	102	Elastic
611	340	55.3	483	2310	100	Fairly Elastic
612	345	50.6	475	2380	102	Fairly Elastic
613	344	50.0	476	2420	98	Elastic
614	340	53.2	483	2410	97	Elastic
626	341	49.7	474	2350	105	Quite Elastic
633	340	52.4	479	2550	97	Elastic
Average	340	52.6	478	2410	99.9	

BAKING TESTS OF THE STRAIGHT FLOURS MILLED FROM THE FIFE AND BLUESTEM WHEAT SAMPLES.
Crop of 1910.

577	336	55.9	485	2675	105	Elastic
594*	340	52.1	476	2325	99.9	Fairly Elastic
628	340	52.6	482	2300	97	Rather short
629	340	53.5	483	2300	99	Rather short
630	340	53.8	480	2490	--	Elastic
631	340	54.1	483	2400	--	Elastic
632	340	55.0	483	2650	--	Elastic
Average	339.4	53.9	486	2465	100.2	

*Average of samples Nos. 594 and 610 to 625 inclusive.

These tests show the straight flours milled from fife and bluestem samples to be a little better on the average than the Velvet Chaff samples as regards baking qualities, although in a number of cases Velvet Chaff wheat flours gave results better than the average of the fifes and bluestems.

Desirable baking flours should give a loaf volume of not less than 2300 cc. when baked by the method used, the loaf volume being a comparative quantitative expression of the elasticity of the dough. Good straight flours should mark not less than 95 in color. The tables show that none of the samples failed to exceed the minimum figures quoted. Also that certain of the fife and bluestem samples are inferior to the average of the Velvet Chaff samples in the matter of loaf volume.

The results as presented above formed the basis of action on the part of the Wisconsin Grain and Warehouse Commission which resulted in changing the grades, and under their classification they say:

"The Commission, believing that Velvet Chaff has been unduly discriminated against, have, in conjunction with the North Dakota Railway Commission and with the cooperation of Prof. Ladd of North Dakota, had tests made of its relative value compared with fife and bluestem varieties. These tests were made at the Fargo Agricultural College under the direct supervision of Prof. Ladd and are unquestionably correct. We will grade velvet chaff wheat the same as fife and bluestem varieties, but will not put it in a higher grade than No. 1 Northern."

SOIL ANALYSIS.

During the year there have been analyzed a number of samples of soil from the demonstration farms as well as samples which have been submitted from other sources. This work has been done by Mr. Ince. The samples from the demonstration farms are as follows:

No. 1047 S—Soil from the demonstration farm at Jamestown.

No. 1048 S—Soil from the demonstration farm at Wahpeton.

No. 1049 S—Soil from the demonstration farm at Starkweather.

No. 1050 S—Soil from the demonstration farm at McLeod.

No. 1051 S—Soil from the demonstration farm at Rugby.

No. 1052 S—Soil from the demonstration farm at Washburn.

No. 1053 S—Soil from the demonstration farm at Hoople.

No. 1054 S—Soil from the demonstration farm at Hazelton.

No. 1055 S—Soil from the demonstration farm at Portland.

No. 1137 S—Soil from the demonstration farm at Wahpeton.

No. 1138 S—Sub-Soil from the demonstration farm at Wahpeton.

Laboratory No.	Organic and Volatile	Insoluble Residue	Iron Fe_2O_3	Alumina Al_2O_3	Lime CaO	Magnesia MgO	Soda Na_2O	Potash K_2O	Phosphoric Acid P_2O_5	Nitrogen	Humus
10478	8.97	82.63	2.77	3.59	.97	.85	.25	.44	.105	.21	2.55
10488	9.42	77.04	5.07	5.67	.65	1.14	.76	.20	.074	.148	2.39
10498	9.78	80.71	3.00	4.10	.97	1.06	.26	.44	.13	.258	3.33
10508	6.72	89.08	1.40	.95	.61	.52	.24	.175	.09	.202	1.40
10518	9.54	80.24	2.97	3.81	1.39	1 09	.30	.29	.127	.29	2.56
10528	8.5	81.99	2.96	4.55	.78	1 03	.27	.43	.164	.21	2.48
10538	9.33	80.86	3.00	3.96	.86	1.04	.40	.38	.14	.26	4.06
10548	9.32	80.15	3.60	4.23	.87	1.09	.23	.36	.14	.257	3.04
10558	8.05	78.31	2.67	2.37	3.59	1.25	.375	.30	.16	.214	1.09
*11378	9 37	79.41	4.76		.86	.60	.29	.41	.124	.287	4.28
**11388	6.95	81.74	5.21		.77	.70	.11	.28	.103	.225	2.91

* Sample as analyzed contained 4.06% moisture.

** Sample as analyzed contained 3.70% moisture.

There were also examined three samples of soil from the Adams farm:

No. 1139 S—Surface soil taken to the depth of 8 inches from different parts of the field.

No. 1140 S—Soil taken from below the surface samples to a depth of from 8 to 18 inches from different parts of the field, the same as the previous sample.

No. 1141 S—Soil taken from below the foregoing sample from a depth of 18 to 26 inches from different parts of the field.

	Surface Soil	Sub-soil	Sub-soil 18-26 in.
Moisture	6.94	5.26	5.23
Organic and Volatile matter	8.74	7.81	7.38
Insoluble residue, sand, etc.	74.99	75.28	74.38
Iron, Fe_2O_3) Alumina, Al_2O_3)	7.24	9.08	9.71
Lime CaO	.33	.25	.56
Magnesia MgO	.87	1.32	1.40
Soda K_2O	.53	.56	.59
Phosphoric acid P_2O_5	.126	.112	.115
Nitrogen	.295	.208	.195
Humus	4.82	4.27	3.80

There have also been made partial analysis of a number of soils which have been submitted as follows:

No. 1038 S—Sample of surface soil from the Streeter Farm at Larimore.

No. 1039 S—Sample of sub-soil from the Streeter farm at Larimore.

No. 1040 S—Sample of soil submitted from Park River from J. P. Johnson. This soil was black from the presence of alkali, and our analysis showed its alkalinity to be, calculated as sodium carbonate 0.52%.

No. 1066 S—Sample of soil submitted by Geo. C. Rust from Marion, N. D., from his ranch in Montana.

No. 1069 S—Sample of soil submitted by Alfred Simmons, Dwight, N. D.

No. 1072 S—Sample of soil from A. B. Anderson, Balfour, N. D. This soil did not produce good crops, and germination tests showed that plants would germinate but make very little growth. There was present considerable black alkali and the alkalinity of the soil, calculated as sodium carbonate, amounted to .515%. The addition of a large amount of gypsum, or land plaster, was sufficient to neutralize the black alkali so that its effect was not manifest on the growth of barley.

No. 1081 S—Soil submitted from alkali spots by H. Jacobson, Fingal, N. D. Alkalinity calculated as sodium carbonate amounted to .215%. Practical tests with barley and other grains were successful for some time, but later, as the growth advanced, turned brown and dried showing the presence of a large proportion of alkali.

Laboratory No.	Moisture	Organic and Volatile	Insoluble Residue	Lime CaO	Potash K2O	Soda Na2O	Phosphoric Acid P2O5	Nitrogen
1038S	1.94	5.09	85.99	2.19	.23	.38	.225	.141
1039S	1.25	3.81	85.33	3.22	.20	.48	.303	.087
1040S	16.83	16.56	53.32	2.88	.20	.40	.347	.58
1066S	2.64	6.29	76.99	2.19	.30	---	.347	.115
1069S	1.97	4.47	87.10	.51	.28	.54	.122	.163
1072S	1.22	9.22	-----	----	---	---	.075	.195
1081S	6.65	15.43	-----	----	---	---	.16	.22

MILK ANALYSIS.

A number of samples of milk have been analyzed, submitted from various sources, some of these being cows' milk and others mother's breast milk. The following table indicates the results for these samples:

		Solids	Ash	Fat	Casein	Sugar
1055S	Mother's	11.13	.12	2.78	1.25	6.98
1010S	Cow's	13.38	.70	4.49	3.48	4.71
1011S	Mother's	12.26	.14	3.49	1.21	7.42
1018S	Cow's	16.10	.72	7.52	3.23	4.63
1020S	Cow's	-----	---	5.70	----	----
1021S	Cow's	-----	---	4.20	----	----
1096S	Mother's	13.29	---	5.55	1.27	----
1097S	Mother's	13.41	.14	4.20	1.40	7.64
1118S	Mother's	11.89	---	2.57	2.39	----
1129S	Mother's	11.59	.15	2.44	2.84	6.07
1145S	Mother's	10.81	.14	1.80	1.45	7.42
1153S	Cow's	15.74	.67	5.60	4.54	4.93
1161S	Mother's	12.18	.21	2.89	1.74	7.34
1162S	Mother's	11.25	.19	2.52	1.43	7.11

AMMONIATED LAWN LIME, Superior Chemical Co., Louisville, Ky. This sample, No. 1034 S, was submitted by Mr. D. R. Lewis, Fargo, N. D., and analysis showed it to contain:

	Percent
Insoluble residue, sand, silica, etc	58.48
Nitrogen	3.29
Equivalent as ammonia NH_3	4.23
Lime CaO	1.23
Iron Fe_2O_3	5.28
Sulfuric acid So_3	19.50

Nitrates	0.00
Phosphates	0.00
Total alkalies	1.42
Potash K_2O	.05

This would be equivalent to a product of about the following composition:

	Percent
Insoluble residue, sand, silica, etc	58.48
Ammonium sulfate	15.51
Lime carbonate	2.19
Iron sulfate	16.11
Total alkalies	1.42
Potash K_2O	.05
Water of crystallization and undetermined	3.29

Our analysis shows that approximately three-fifths of this product is ordinary white sand; about one-tenth is iron sulfate; and approximately one-fifth is ammonium sulfate, together with a small amount of lime mainly as carbonate. The sand can have no actual value as a fertilizer nor as a herbicide. Iron sulfate can be bought for from one to two cents per pound, and the material in this twenty-five cent package could be bought anywhere for less than ten cents.

BONORA, Nature's Plant Food, Bonora Chemical Co., 488 Broadway, New York. Our analysis of the sample as submitted showed it to contain the following:

	Percent
Total nitrogen	16.10
Ammonia (NH_3)	14.08
Potash K_2O	3.72
Soda Na_2O	12.64
Lime CaO	0.00
Phosphoric acid P_2O_5	4.34

The product is soluble in slightly acidulated water while qualitative tests show the presence of chlorine, alumina and sulfur trioxid. Bonora is sold at 65 cents per pound. If we take the price of chemicals for the chemically pure product we find that the cost would be, as based on the foregoing analysis, 4.11 cents, leaving an exceedingly

good profit for those who manufacture and handle the product.

KALAKA, Wizard Lawn Producer, The Dormant Sod Co., Union Stock Yards, Chicago, Ill. A five-pound package costs $1.00 and is claimed to cover 1,000 sq. feet of new lawn and to renew 2,000 sq. feet of old lawn. The actual weight of the package was found to be 4½ pounds. Analysis showed it to be composed of the following:

	Percent
Moisture	7.84
Ash	20.86
Nitrogen	2.41
Lime CaO	3.41
Potash K_2O	1.42
Phosphoric acid P_2O_5	2.04
Inert material	74.20

This sample was found to contain 25.80 percent of lawn seed, and an examination of the seeds showed as follows:

	Percent
Red Top	20.30
Blue grass	4.20
White clover	1.10

A germination test showed as germinating:

	Percent
Red top	69.00
Blue grass	87.00
Clover	74.00

Further results are given with regard to practical tests made with this sample by Mr. Ince in the Biennial Report for the College.

TESTS OF CALCIUM CARBIDE.

These samples of calcium carbide were submitted to the Department with the request that we ascertain the yield of gas per ton, the purity of the gas, that is, the acetylene; and, therefore, the relative value of the three products as gas producers.

	No. 1	2	3
Acetylene per ton, cu. ft.	10,000	10,150	10,300
Purity of gas, percent	95	90	95
Acetylene gas pure, cu. ft.	9,500	9,135	9,785

MISCELLANEOUS ANALYSIS.

During the year a very large number of samples have been submitted for tests and analysis and a few of the more important ones are worthy of publication as being of general interest to the farmers of the state.

1061 S—Ground Feed. This was a mixture of oats and spelts as purchased from the elevator and submitted by J. Papke, Stanley, N. D.

	Percent
Moisture	7.44
Ash	3.40
Fat	6.61
Crude fibre	9.16
Protein, Nx6.25	15.75
Nitrogen free extract	57.64
Total	100.00

1068 S—Jones' Potato Bug Killer. O. S. Jones Seed Co., Sioux Falls, S. D. Examination of this product showed it to be partially soluable in water, giving alkaline reaction.

	Percent
Ash	18.30
Loss on ignition	81.71
Insoluble in hydrochloric acid	.80
Arsenic As_2O_3	16.05

The ash was found to contain considerable aluminum, lime and some iron, while a microscopic examination showed the presence of arsenic trioxid, starch and a little sodium chloride. The product is apparently a mixture of arsenic, clay, starch, etc.

1076 S—Cement. Sent in by Geo. H. McKay, Nesson, N. D.

	Percent
Loss of ignition	3.65
Silica SiO_2	20.43
Alumina Al_2O_3 / Iron Fe_2O_3	10.37
Lime CaO	61.35
Magnesia MgO	2.74
Sulfuric anhydride	1.46
Total	100.00

The time required for initial setting was three hours and fifteen minutes and for the final setting six hours and forty-five minutes. As far as could be judged from the small sample, it was of good quality but slow in setting.

1088 S—Two samples of clay, one a dark sample and the other light colored, were submitted by A. B. Cox, Valley City, N. D., and our analysis showed these samples to contain:

	Dark	Light
Silica SiO_2	56.40	10.70
Alumina Al_2O_3 / Iron Fe_2O_3	10.40	1.30
Lime CaO	11.30	44.60
Magnesia MgO	1.80	3.10
Sulfur trioxid SO_3	1.60	.80
Loss on ignition	12.60	39.50
Alkali and Undetermined	5.90	0.00
Total	100.00	100.00

1095 S—Sample of Iron Ore submitted by E. K. Hogenson, Grafton, N. D.

	Percent
Silica SiO_2	7.30
Alumina Al_2O_3	3.30
Iron Fe_2O_3	60.40
Manganese MnO_2	.75
Lime CaO	2.10
Magnesia MgO	trace
Sulfur trioxid SO_3	.09
Phosphoric acid P_2O_5	1.44
Loss on ignition	27.30
Total	102.68

SUGAR BEETS: Three samples of sugar beets grown on the Sub-Experiment Station farm at Williston, N. D., were submitted by the Superintendent, E. G. Schollander: No. 1110 S being Kleins Wanzleben, 1111 S Vilmorine Light, and 1112 S Idaho.

	1110	1111	1112
Average weight	1 1-5lb.	1 1-5lb.	1 3-5lb.
Total solids, pulp	22.75	27.81	28.89
Total solids, juice	22.83	24.46	25.93
Sucrose	18.40	20.60	21.31
Coefficienct of purity	80.59	84.21	82.14

CLAYS. Two samples of clay were submitted by W. H. Westergard of Williston, N. D.; one sample taken from above the coal seam, No. 1121 S, the other taken beneath the coal seam, No. 1122 S:

	1121	1122
Silica SiO_2	57.0	59.1
Alumina Al_2O_3 } Iron Fe_2O_3 }	18.1	18.7
Lime CaO	6.4	6.4
Magnesia MgO	3.6	1.2
Loss on ignition	10.6	10.6
Sulfur trioxid SO_3	trace	trace
Alkalies (by difference)	4.3	4.0
Total	100.00	100.00

1125 S—Clay, or a product used for plastering both exterior and interior of a long building in Montana, submitted by J. L. Lossing, Redstone, Mont.

	Percent
Silica SiO_2	80.3
Alumina Al_2O_3 } Iron Fe_2O_3 }	11.7
Lime CaO	trace
Magnesia MgO	2.5
Loss on ignition	4.4
Alkalies, etc. (by difference)	1.1
Total	100.00

1126 S—Barley, submitted by Bertel Nelson, Flaxton, N. D.

	Percent
Moisture	11.42
Ash	2.12
Fat	2.48
Crude fibre	4.25
Protein Nx6.25	16.37
Nitrogen free extract	63.36
Total	100.00

FEEDING STUFFS.

1131 S—Sample marked Feed, submitted from Walhalla Milling Co., Walhalla, N. D.

1132 S—Mixed Feed, Corn and Oats in equal parts, submitted by O. G. Moulton, Fargo, N. D.

	No. 1131	1132
Moisture	6.12	11.35
Ash	3.72	3.12
Crude fibre	13.34	8.25
Fat	5.52	5.45
Protein Nx6.25	12.93	10.56
Nitrogen free extract	58.37	61.27
Total	100.00	100.00

The first sample contained large quantities of pigeon grass seed, some lambs quarters, marsh elder, sunflower and considerable cracked or ground wild oats. The last sample contained some wheat, flax, pigeon grass and wild oats.

1134 S—Special Molasses Feed, sent in by Ben Tronslin, Edinburg, N. D.

1135 S—Sample of Sucrene Dairy Feed from the American Milling Co., Chicago.

1136 S—Sample of Sucrene Horse and Mule Feed, from the American Milling Co., Chicago.

	1134	1135	1136
Moisture	2.83	12.02	10.92
Ash	9.70	7.57	4.95
Fat	5.56	6.02	4.06
Protein Nx6.25	12.50	18.12	10.87
Crude fibre	17.50	12.33	12.49
Nitrogen free extract	51.91	43.94	56.71
Total	100.00	100.00	100.00

1146 S—Flax Bran, a product submitted by Atwood, Stone & Co., Minneapolis, Minn.

1154 S—Middlings, submitted by Oakes Milling Co., Oakes, N. D.

1155 S—Bran Feed, Oakes Milling Co., Oakes, N. D.

1158 S—Sample of Ground Oil Meal. Grand Forks Seed Co., Grand Forks, N. D., submitted by B. S. Winston, Orr, N. D.

No.	1146	1154	1155	1158
Moisture	5.49	6.88	7.52	7.62
Ash	7.34	3.94	6.34	6.37
Fat	3.48	5.66	4.40	7.27
Protein Nx6.25	7.37	20.38	17.44	35.03
Crude fibre	40.78	5.82	11.26	9.84
Nitrogen free extract	35.54	57.32	53.04	33.87
Total	100.00	100.00	100.00	100.00

Many samples analyzed will be reported upon in special and regular bulletins issued by the Department, also in Part II, the same being the Annual Report of the Food Commissioner for the year of 1910. Owing to the condition of our laboratories, it has been impossible to continue many of the lines of investigation which were in progress at the time of the fire. It is hoped, however, that in the near future we will be located in our new laboratory where facilities will be afforded for taking up lines of work for the time being discontinued.

Respectfully submitted,

E. F. LADD,
Chemist.

DEPARTMENT OF BOTANY

Director J. H. Worst

Sir: I, herewith, transmit to you an outline report of the work of the Department of Botany of the North Dakota Experiment Station for the year ending December 31, 1910. The work of the year has been conducted upon the same general propositions as outlined in previous years and upon such new propositions in a preliminary way as seemed necessary to determine lines of possible future investigation. The work upon the Adams investigations has been pushed with all possible energy and I am pleased to say has resulted in discoveries and conclusions which the writer believes will prove of inestimable value to the farming public through the influence of the work upon future methods of cropping to cereals.

For a number of years our work has busied itself with a study of the plants found resident in the soils of old cultivated lands and in the virgin soils, and of the micro-organisms that are found in the soils and upon cultivated plants upon such soils with the result that we have decided that many areas of long cultivated lands which have been supposed to be depleted chemically so as to no longer produce proper cereal crops are not of necessity so depleted, but that in many cases these lands are yet very fertile, though contaminated with certain fungal organisms which are able to attack the cultivated plants, destroying their roots, injuring the straw and shrivelling the grain. Our conclusions indicate that these organisms often do the greatest damage in years when otherwise the climatic and soil conditions are particularly favorable for a large growth of grain.

The conclusions which we have reached are particularly interesting because of their bearing upon the general processes of agriculture, especially upon the work of cropping to cereals. These conclusions explain many of the anomalies of agriculture which were not explainable upon any other

condition, and if we are right, give great encouragement to proper methods of cultivating the small grain crops. **The fact that our experiments, taken as a whole, tend to prove definitely that the soil is not often materially depleted, but that the deterioration in yield and quality of grain is more specifically to be assigned to troubles caused by internal seed infection and soil infection,** furnish a clean argument which all farmers can easily understand for proper seed selection, proper seed grading, proper seed treatment or disinfection; and especially for a proper series of crop rotations which shall tend to allow the ground to become free from disease contamination characteristic of the various crops. The work also has a clear cut bearing upon the methods of handling barn-yard manures; for we have proved definitely **that manures which are made in stables where diseased straw has been used for bedding are very detrimental when spread without composting upon lands that are to raise the same kind of crop as that from which the bedding was made.** For example, manures made from flax straw make soils flax-sick after one application, if the manures are not composted; and, likewise, manure made from wheat straw when used fresh upon wheat lands are also very destructive because they convey to the soil the characteristic root blighting organisms. These facts do not indicate that we should use less barn-yard manures but that we should study upon what crops to apply them and how to better compost the manures so as to free them from infecting organisms.

I will not, at this time, attempt a detailed report of the results of these studies. The Department will, as soon as it can get together suitable materials, from time to time publish definite bulletins illustrating the different features. So far as wheat is concerned, Press Bulletin 33 and Bulletin 87 represent the beginning with reference to this line of publication.

In flax work, we have continued our studies and find that aside from the regular wilt producing organism there are other parasites which act upon the roots and upon the seed of the flax plant, but that they are minor influences as compared to the regular wilt producing organisms which we have previously described in Bulletins 50 and 55, and other publications of the Experiment Station.

Work in the Pure Seed Laboratory: In the Biennial

Report of the Station and in the 20th Annual Report of the Experiment Station we have outlined the work of the Pure Seed Laboratory. We have compiled extensive lists of the various sorts of weed seeds and adulterants which we have found in the various samples of seed examined. This includes over thirty typewritten pages and will be better used in a specific bulletin at some future time. Since our last report, July 1, 1910, until January 1, 1911, the laboratory has analysed 595 samples of seed. Of these 236 samples were garden seeds tested for viability. The work of this portion of the season is but a continuation of that previously reported, and indicates the frequent occurrence of Dodder in Alfalfa, Quack-grass in Brome Grass, and occasional seeds of Canada Thistle in other seeds, especially in Canada Blue Grass. We have followed the policy of notifying the sender immediately when the samples are found to be of illegal character and in case they are seed merchants, we have asked them to withdraw the samples from sale in the state. In so far as we know, all of these requests have been granted cheerfully.

We have been able to add in the way of equipment to the laboratory several necessary pieces of apparatus including a binocular microscope, very essential to proper methods of seed measurement and for accurate seed examination.

During the summer season the seed analyst, Mr. Stevens, has been engaged in visiting fields throughout the state, gaining information with regard to distribution of most noxious weeds and collecting quantities of standard weed seeds for critical study. The laboratory has prepared a number of such collections for distribution to seed houses and parties interested in learning the character of such seeds. He also made some good exhibits illustrating the work of the laboratory for county fairs and state fairs, and for exhibition on the Better Farming Train. Addresses have been delivered both by the Commissioner and his assistants at various points in the state with regard to the workings of the laboratory and the requirements of the law. Since the last report we have published three circulars, 3, 4, and 5 respectively. These circulars are sent especially to seedsmen, and to all others who desire them for the purpose

of making the methods of the laboratory and the requirements of the law better known.

Work with Bacteria and Fungi of the Soil. In the Division of Bacteriology Professor Beckwith has placed his entire station time upon soil examinations with the view of learning the bacterial and fungus content of certain regular plots of soil. Of these plots there are twenty for which we have definite records of all the crops that have been grown on them, the manner in which the plots are cultivated and seeded, the kind of seed which is placed on them and the kind of fertility which is used in each case, and the particular method of disinfecting the soil, if any. For the bacteria, records have been taken from a definite depth, two inches, and for the purpose of determining the number of denitrifyers and the number of nitrifyers. For the denitrifyers we have used beef ager prepared according to the standards of the American Public Health Association; and for the nitrifying organisms the formula used is that of Lipman of New Jersey Experiment Station. The tabulated results indicate that there is very considerable variation in the bacterial content of these soils both as to the total number of bacteria present and as to the ratio of the two classes to each other.

Examinations have likewise been made from the soil of these plots to determine what variety of fungi are present in the soil. Tabulated records are kept of the various kinds obtained. The genera most commonly found are **Fusarium, Colletotrichum, Macrosporium, Alternaria** and **Helminthsporium** with numerous other organisms commonly recognized to be ordinary Saprophytes. The organisms above listed are also found in our work to attack various portions of the cereal grains—roots, straw and seed, especially of wheats, oat, barley and flax; and, as these examinations by Professor Beckwith show that these organisms are of common occurrence in the soil, this explains the reason for the so called soil sickness. Our various lines of work show that these fungi are present in soil cropped continuously to a certain cereal in much greater numbers or quantities than in virgin soil.

Approximately three thousand tests have been made during the year in the two lines of work mentioned above.

We have inaugurated a survey of soils in the state up-

on a similar plan to correspond with these soil studies on the station plots, and also a survey of the grain, stubble and straw as produced in various parts of the state. The work so far as soils are concerned has been on the Red River Valley soils and those taken from the Demonstration Farm at Rugby. We expect to extend this particular line of work during the coming season.

On account of certain additional funds which the Department has received in the interests of our flax experiments we have been able to largely extend the experimental work in this field and its usefulness in our correspondence with the farmers.

The plans for the work for the coming season will not be materially changed from those as outlined in previous seasons except in so far as the results which we have gained indicate possible modifications.

Respectfully submitted,

H. L. BOLLEY,
Botanist and Plant Pathologist.

DEPARTMENT OF HORTICULTURE

Director J. H. Worst,

Sir: The following lines of work in the Department of Horticulture and Forestry were undertaken during the year 1910:

FORESTRY.

No additional planting of forest trees was made in the co-operative experiments with the U. S. Forest Service since trees for this purpose were not to be obtained.

This was, doubtless, fortunate as the very severe and prolonged drouth would necessarily have killed the greater number, particularly of the coniferous trees. The untimely warm dry weather in March followed by severe freezing in May and a practically rainless summer, made a most trying season for all trees that were not well established by several years' growth.

The behavior of all the different species of trees, as influenced by freezing and drouth was as follows:

Western Yellow or Bull Pine (Pinus ponderosa) was apparently not affected by the late frosts and trees that were well established made about the normal growth during the season.

European Larch (Larix Europea) started growth in April and was severely injured by freezing in May. None of the trees fully recovered and they made practically no growth during the summer.

Colorado Blue Spruce (Picea pungens) was uninjured in the spring and suffered but little from the drouth except in newly planted specimens.

Norway Spruce (Picea excelsa) slightly injured by frosts in May. Exposed trees were badly injured and in some instances killed by drouth and hot winds. Old trees growing in heavy plantations were uninjured and made a fair growth.

Red Cedar (Juniper Virginiana). These trees which were brought from the Bad Lands of this state five years ago, are remarkably resistant to cold, heat and drouth. In most instances they made nearly their normal growth.

Box Elder (Acer negundo). The early growth was entirely killed in the spring and the trees made a very poor recovery. On account of this and the dry weather, they made a very poor season's growth.

Soft Maple. (Acer saccharinum). Recovered well in most instances the rather light injury in the spring and during the season made about half normal growth.

White Birch. (Betula papyrifera). Was considerably injured in the spring but recovered well early in the summer. On account of drouth the growth was very slow, averaging six inches as compared with three feet the previous season. New transplated trees suffered severely from drouth.

White Ash (Fraxinus Americana). Owing to its lateness in starting, this tree was uninjured in the spring. On account of its deep rooting habit, it seemed to be but little influenced by drouth.

Green Ash (Flaxinus lanceolata). This is the native ash of North Dakota. This tree like the white ash, showed but little effect of freezing or drouth where they were growing in a soil that had been kept in shape by cultivation. Neglected trees of both species made but little growth.

White Elm (Ulmus Americana). Was but little affected by freezing and established trees made from one-half to two-thirds normal growth.

Hackberry (Celtis occidentalis). The early spring growth was all killed, but the trees recovered well and made a fair growth in cultivated soil. The foliage was badly injured by the hot winds.

Cottonwood (Populus deltoides). This includes also the Carolina poplar and the Norway Poplar. The spring growth was not greatly injured by freezing. Young trees made about half their normal growth, older ones somewhat more.

Willow (Salix alba). Exposed trees were considerably injured by freezing. The season's growth was about halt of normal.

Russian Wild Olive (Eleagnus augustipolia). Apparently but little affected by frost or drouth.

Black Walnut (Juglaus nigra). This tree was uninjured by frost except that the blossoms were killed. The summer growth was remarkable, averaging about two feet for trees of all ages. This is undoubtedly due to the long tap root reaching down to moist soil. It is not expected this tree would grow well in very dry locations.

These studies would indicate the drouth resistant trees are the western conifers like the yellow pine, Colorado spruce and red cedar. The deep rooting trees like the ash and walnut and those with a special type of foliage like the Russian wild olive.

FRUIT GROWING.

A new plantation of small fruits was started in which were placed many of the newer varieties of strawberries and bush fruits. With no other means of irrigation than watering from a tank, it was impossible to keep many of the plants alive during the prolonged drouth.

In the older fruit plantations, the several severe frosts coming after blossoming, destroyed all of the fruit so that no results were obtained.

VEGETABLES.

A full line of experiments, with all the standard garden crops involving cultural methods, tests of different strains and varieties and selection for improvement, was inaugurated, but owing to the unfavorable season, could be completed only in part. Some progress was made with sweet corn, peas, and tomatoes; but nothing could be accomplished along most of the lines of work undertaken.

INJURIOUS INSECTS.

The season was a disastrous one in many parts of the state on account of insect ravages as well as loss from

drouth. More or less damage from various insects was reported but the grasshoppers were the only ones that caused serious loss.

The damage was more or less common over the eastern third of the state. In a few instances total losses were reported on from eighty to one hundred acres of grain. Meadows and pastures suffered severely and fruit trees and shrubs to a considerable extent. Losses to garden crops were also very common.

The destruction was caused almost wholly by three native species, namely, the two striped locust (Melanoplus Vivitattus) the red legged locust (M. ferrier-nibrum) and the lesser migratory locust (M. atlantis).

In July, trips were made to some of the worst infested regions to study the conditions and render any assistance possible. At that time but little could be done except to note where eggs were being laid and provide for their destruction by fall plowing, where this was impossible, as along road-sides, road scrapers were used to turn the eggs out to the sun and wind.

It was noted that very few of the grasshoppers were infected by parasites and for that reason the outlook for 1911 promises even worse than for 1910.

On the other hand the fertility of the females seemed to be considerably below normal. This was accounted for on the ground of the unusually dry hot season and perhaps also a reduced food supply.

Another factor that in many places was evidently working toward the grasshoppers' destruction was the large number of crickets that made their appearance in July and August. These we found burrowing into and eating the nests of grasshopper eggs.

In certain plats that were examined on the college farm, but few of the nests had escaped partial or complete destruction. We had a few other reports to the same effect but not enough to enable us to determine the extent of this condition.

Printed matter was furnished to all the farmers through the press of the state giving instructions as to the means of exterminating the grasshoppers.

PUBLICATIONS.

Bulletin No. 88 on Windbreaks and Hedges issued by this department, gives an account of what has been accomplished at this station along that line, together with illustrations of the same and full directions for growing trees for that purpose.

ASSISTANTS.

In April 1910 Mr. A. McMeans, formerly of the experiment station of Guelph, Ontario was engaged as assistant horticulturist. Mr. McMeans is devoting his time chiefly to the cultivation and improvement of garden crops.

Respectfully submitted,

C. B. WALDRON.

VETERINARY DEPARTMENT

Director J. H. Worst,

Sir: Permit me to submit the following report on the station work done during the year ending February 28, 1911, by the Department of Veterinary Science.

The research work of this department is being carried on under the provisions of the Federal Adams Act and was during the period reported on entirely confined to the systematic investigation of "swamp fever" in horses.

This type of work, which before had to be done under conditions most adverse to thoroughness and accuracy, can now be taken care of in an adequate manner by the laboratory and stabling facilities provided by the New Veterinary Building, which has now been occupied for a year.

The detailed results of the investigations are collected in a manuscript now ready for the printer, but for the sake of briefness, we beg to sum up the following conclusions warranted by our experimental results. They are:

1. Swamp fever is a disease of infection, transmissible by subcutaneous and intravenous injections and the injection of both blood and urine coming from affected horses.

2. The specific virus is capable of passing through bacteria proof filters and this virus cannot be demonstrated by the ordinary bacterioscopic methods.

3. The specific virus leaves the body of infected animals by means of the urine and the latter excreta, by contaminating food stuffs and drinking water is the most probable means of transmission.

4. The disease is essentially a septicaemia anatomically marked by sub-serous and sub-endocardial hemorrhages in the more acute forms, by occasional involvement of the lymphnodes and spleen, by degenerative changes of the parenchyma of the heart, liver and kidneys, and by certain alterations in the bone marrow of the long bones of the limbs.

5. The chief and most constant manifestations of the disease are fever and albuminuria. The former is remittent or intermittent, not uncommonly at more or less regular intervals, while the latter is transitory and not uncommonly synchronous with the febrile exacerbations.

6. The popular conception of "swamp fever" being primarily an anemia is erroneous as many of the experimental cases terminate fatally without a marked reduction in the red blood cells.

7. Certain experimental cases may apparently recover and fail to manifest any notable features of the disease. They are seemingly enjoying the best of health, while their blood is still extremely virulent and they may remain in this condition for two years or possibly longer.

8. The most likely therapeutic agents have failed to destroy the virus in vivo.

9. In the light of our present knowledge, we have to depend upon such prophylactic measures as destruction of diseased animals, segregation of suspects, care in introducing new horses into a stable, the safeguarding of food and water supply from urine contamination and stable disinfection.

With the acquisition of the information on hand, the real problems in connection with this disease become more apparent, and as soon as our present phase of the work is finished, the future work will be shaped toward its solution.

The work now in hand consists of enquiries into the effect of severe freezing upon the virus and the possibility of transmitting the disease by means of the faeces. The researches are essentially finished and the department is now engaged in checking up the results.

For the coming year our investigations will deal with:

1. A reliable method of diagnosis as we recognize in this the most present need in dealing with the swamp fever. It is probable that most of our acute and sub-acute cases remain unrecognized as they commonly terminate without showing the anaemia which is considered the most constant symptom of the disease.

2. The possibility of inducing a more or less lasting immunity by artificial methods, with a view of affording protection to animals exposed to infection.

3. In spite of the discouraging features met while endeavoring to eliminate the disease by means of medicinal agents, the possibility of finding a specific remedy is by no means disproven.

Respectfully,

L. VAN ES,
Station Veterinarian.

STATEMENT

United States Appropriation, 1909-1910.

Receipts	Hatch Fund	Adams Fund
To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30th, 1910, under acts of Congress approved March 2nd, 1887, (Hatch Fund) and March 16th, 1906, (Adams Fund)	$15,000.00	$13,000.00
Disbursements.		
Salaries	$ 9,353.93	$ 7,974.84
Labor	4,315.83	1,247.98
Publications	1,115.91	
Postage and Stationery	23.92	
Freight and Express		
Heat, Light and Water		
Chemical Supplies		92.36
Seeds, Plants & Sundry Supplies	75.62	444.74
Fertelizers		14.25
Feeding Stuffs	35.29	795.68
Library		
Tools, Implements & Machinery	64.50	299.51
Furniture and Fixtures		78.00
Scientific Apparatus		1,572.64
Live Stock		480.00
Traveling Expenses		
Contingent Expenses	15.00	
Building and Repairs		
Total	$ 15,000.00	$13,000.00